行政院國家科學委員會補助專題研究計畫 ■ 成 果 報 告 □期中進度報告

以教材標準化及 Web 2.0 技術提升線上學習成效 --以多媒體教材為例

計畫類別：□ 個別型計畫　■ 整合型計畫

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執行單位：淡江大學、成功大學、致理技術學院、南台科技大學

中華民國 97 年 10 月 15 日

Table of Content:

Abstract (Chinese)

本研究計畫將建構於遠距學習規格上，所有參與計畫學校與老師們都對此具備研究興趣與基礎，在我們的規劃下，將著重於 SCORM 與 QTI 等兩大數位學習與評量規格。此外，由於 Web 2.0 技術為目前發展網頁系統之嶄新技術，本研究團隊將採用 AJAX 與 RSS 技術，並且搭配相關教育理論與 Web 2.0 中其他技術進行整合研究。本計畫之目的在於發展一個整合式的遠距教學平台並與國際遠距教學規格接軌，其中將規劃以教材試題編輯工具、學習內容資料庫、學習管理系統與測驗評量系統等四大主軸作為本整合計畫之發展方向。

本研究計畫主題為「以教材標準化及 Web 2.0 技術提升線上學習成效--以多媒體教材為例」，其下共包含四個研究項目，分別為：

- 基於 IMS Common Cartridge 及 Web2.0 之課程、試題及試卷線上編輯系統
- 以 Web 2.0 為基礎之智慧型學習平台的建置與研究
- 智慧型學習引導暨適性化測驗機制建置
- 多媒體教材 based on Web 2.0 的實徵研究

本研究計畫將結合國內三個主要遠距教學研究團隊進行共同合作，在過去幾年中，本研究團隊已發展了許多遠距教學領域之系統與工具。基於既有的研究成果並且結合創新的研究方法與技術，本研究團隊期望這個計畫能建置出一個整合式的遠距教學系統。我們衷心的希望藉此研究計畫之進行模式，為台灣的學術研究合作樹立良好典範。

Abstract (English)

The proposed research project is based on a common interest, distance learning standards, among joining universities. We focus on SCORM and QTI. Since Web 2.0 technologies are well known new directions for the development of web-based systems, we use AJAX and RSS, along with other concepts elaborated in Web 2.0 in this new joint project. The goal of this new project is to deliver a total solution of distance learning platform, including authoring tools, content databases, learning management systems, and assessment systems.

Four research topics are included in the main project entitled "*Enhancing on-line learning using standards and Web 2.0 technologies – using Multimedia course as an example*"

- A Common Cartridge Authoring Tool based on Web 2.0
- Intelligent Pervasive Learning Management System (iPLMS) based on Web 2.0
- Intelligent Tutoring & Adaptive Testing Mechanism
- Field Study of Web 2.0-based distance learning systems – using Multimedia course as an example

The newly proposed joint project brings together three important e-learning research groups in Taiwan. In the recent years, these groups developed some systems and tools. This joint project will launch an integrated system based on existing results and the newly proposed mechanisms. We hope that, this joint project serves as an example for researchers in Taiwan to collaborate and deliver one strong and robust system for public usages.

Contents

Continuity and passing of traditional education modes are always objects of teachers. It is an ideal of realizing the concept of teaching with entertainments. Due to rapidly development of internet technologies, there are various presentation ways for educational contents and modes. It is easy to get a conclusion that digital learning will play an important role in the future education environment since there are so many resources are taken in the domain of digital learning.

In the digital learning environment, it is a challenge about how to generate sharable learning materials over internet by courses authoring tool. Establishing a set of learning management servers to present contents to learners is also an important issue to researchers. Besides the topics mentioned above, analyzing contents of materials and tests is also a part we want to highlight.

There are four research groups in Tamkang University, Cheng Kung University, Southern Taiwan University and Chihlee Institute of Technology participants in the project to develop courses authoring tool compliant with SCORM and courses administration systems. Some results of difficultness and identifying of materials and tests are also published. In this report, we divide the integrated project into four separate parts to express the research progress and results as follows:

- **Courseware Authoring Tool**
  According to the WEB 2.0 technologies, course editors can authorize learning contents which are compliant to SCORM, QTI and Common Cartridge by browsers built in personal computers. Such tools also support to switch formats in several international learning specifications. Recording and managing learner's profile by using LIP (learner Information Package) defined by IMS are also functions provided by this tool.

- **Learning Management System**
  Learning management system is used for delivering and distributing SCORM+QTI/Common Cartridge compliant digital learning contents in various devices, like personal computer, tablet PC, PDA and cellular phone. Besides, the systems will be integrated with the intelligent tests mechanisms in the third component to provide adaptive learning information to learners.

- **Assessment and Intelligent Learning System**
  The sub system is charge of analyzing data from contents of tests and learning materials based on student problem table and item response theory. Theses analyzed results will be used to generate personal learning guide and adaptive tests for individual learners. The analyzing process will be integrated with the personal learning profiles mentioned in the previous section.

- **Visualization of testing analysis**
  Visualized data of analysis will help teachers to handle learning performance of learners. The tool presents analyzed data with a clear view by data mining technologies and help learners to improve their learning performance. Besides, possible variables to affect digital learning can be observed via the visualized testing analysis.

In the following sections, we'll introduce the researches mentioned above in details and the relevant technologies we used in each research topic.

1. Courseware Authoring Tool

In order to make instructors to perform courseware authoring processes with the advantages of online learning resources, we introduce an authoring system based on Web 2.0 technologies to realize a rich-client authoring environment. With respect to the shareability of learning contents, most of them were stored in the back-end learning management systems or learning content repositories. By utilizing the Web 2.0 technologies, instructors are able to fetch learning contents from back-end servers online and save the cost of downloading learning contents in the same manner. In the other hand, most courseware authoring systems nowadays are formed in standalone applications with serial installation procedures. It's possible for users to install those tools with some special requirements to serve the authoring purposes. However, not all of the users are aware of how to successfully install those tools to meet the specific requirements. As a result, if those extra efforts could be solved by advanced technologies, users will be easier to perform the same tasks and to concentrate on the content constructing. Due to the above mentioned issues within conventional courseware authoring systems, Web 2.0 technologies provide a total solution to serve this goal. With the rich interactions supported in Web 2.0 technologies, instructors are able to use the web browser as their standalone applications to construct learning contents.

■ System Architecture

Our proposed Web 2.0-based online authoring system comprises of two main portions as shown in Figure 1 to facilitate the authoring process. The first portion serves the transformation among various E-learning specifications. This will assure the interoperability and standardization of exporting the authored learning contents to different learning management systems. The second portion is responsible for the integrated functionalities to support the rich-client online authoring processes.

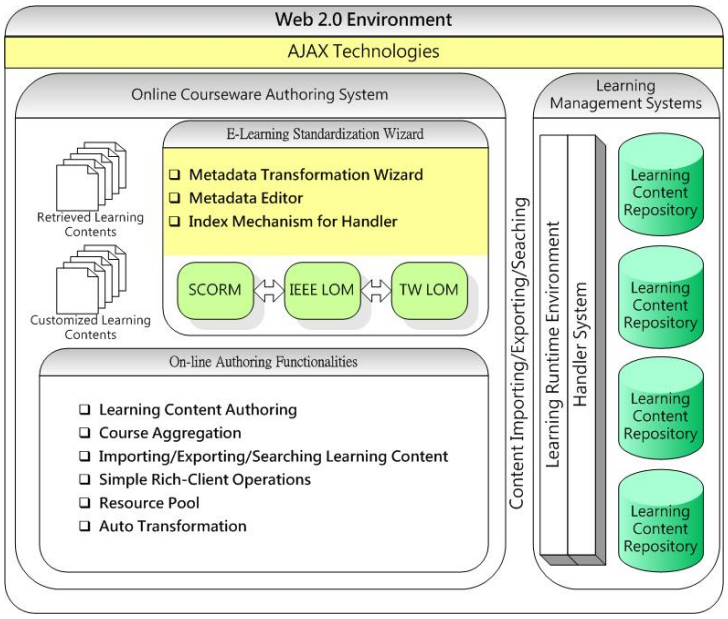

Figure 1. System architecture overview

To distinguish from conventional courseware authoring systems, our proposed idea is based on Web 2.0 environment which provides an easy-to-use browser-based GUI in the open network framework. This will lead to some significant benefits, such as the platform independency and the plenty of learning resources. By using this architecture, instructors are allowed to acquire specific learning resources and reuse them within the same working environment in real-time without dealing with complex procedures existed in conventional authoring systems.

In this architecture, those authored learning contents could be stored in the back-end learning content repositories or preexisted in the local machine. All of the used learning contents will be assigned with a

unique identifier named HandleID proposed by CNRI (Corporation for National Research Initiatives). From the viewpoint of instructors, the reusability of learning contents depends on the precisely defined metadata specifications in each e-learning standard. Accordingly, how to retrieve the specific learning contents will be an essential concern while developing such authoring systems. In our proposed system architecture, a metadata searching wizard is designed to serve this purpose. Instructors are able to retrieve learning contents according to various criteria in metadata fields. The retrieved learning contents will be loaded into the available learning resource pool logically. The term "logically" indicates that those retrieved results are not loaded in physical forms, but in an indexed form. We utilized an indexing mechanism to allocate those retrieved learning resources by referencing to their handlers. After all the authoring processes were completed, those indexed learning contents will be cloned to the back-end learning management system directly without the round-trip downloading and uploading. Of course, if the learning contents were modified in the authoring phase, those modified learning contents will be loaded as duplications by using the Web 2.0 technologies in the asynchronous mode, and instructors are still allowed to have the same operations in traditional manners. All the modifications will be recorded in the back-end server, and as a result, the adjustability will be achieved. Moreover, the versioning control will be maintained to fit the related searching criteria.

■ Web 2.0-based Online Courseware Authoring System

With respect to constructing courseware materials, the user interface of learning content aggregation and arrangement should be included within our proposed idea. And in addition, the specific learning resources could be acquired in many ways, such as online retrieving, and customized designed. Figure 2 shows our developed Web 2.0-based online authoring system. The left panel of Figure 2 provides the necessary functionalities to aggregate learning contents into the course structure.

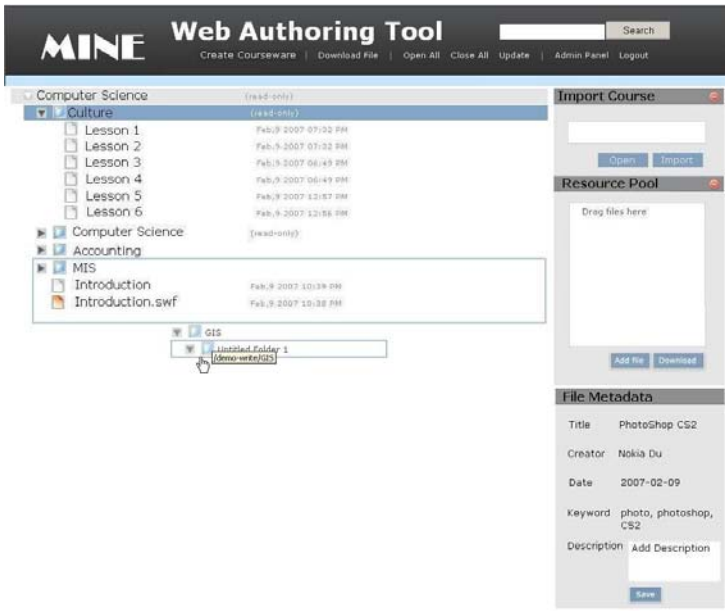

Figure 2. User Interface for online courseware authoring system

In order to provide similar user experience into the authoring system, we utilize the tree-like structure to illustrate the course aggregation. This will bring an easy-to-use authoring environment to instructors. The operations, including real-time drag-and-drop, inserting, deleting, renaming, and arrangement, are easy to be performed via the tree-like structure.

In another hand, our proposed authoring system aims at supporting transformation among various E-learning specifications, such as IEEE LOM, SCORM, and TW LOM. Among those E-learning specifications, a complete description for courseware aggregation should be conformed, and the description

is usually named as “imsmanifest.xml”. The description file comprises of several parts, including the metadata information of learning contents, the information of content organization, and some information of allocating physical data. Those learning resources described in imsmanifest.xml will be archived in a zip file as known as a PIF (Package Interchange Format), and exported to the back-end server.

In the right panel of Figure 2, it provides the necessary functions for acquiring relevant learning resources to be used. For example, the “Import Course” function takes responsibility for loading the retrieved learning contents compliant to various E-learning specifications. Those learning contents will be parsed and loaded into the “Resource Pool”. Instructors are able to aggregate the materials within the resource pool into the course structure by simple drag-and-drop operations. The most different point compared with standalone courseware authoring system is that all the online learning materials and authoring environment are both online. This will save the cost of transferring the retrieved learning resources to and fro the learning management system. As a result, instructors do not have to manipulate plentiful physical learning resources while content aggregation phase.

In order to fully support the shareability of learning contents, a set of metadata fields should be accomplished before exporting to the back-end server. Figure 3 illustrates our proposed online metadata editor. The metadata editor provides complete items in nine categories based on IEEE LOM, and instructors are allowed to fill the fields according to their particular pedagogical needs. The main reason that we utilized IEEE LOM to be the primary consideration lies in the fact that SCORM and TW LOM were both revised based on IEEE LOM. After the accomplishment of metadata filling, those filled items will be analyzed for the further transformation to be compliant with other E-learning specifications.

Figure 3. Online Metadata Editor

The IEEE LOM can be considered as the default output specification while exporting the authored learning contents to the back-end learning management system. In the “Transformation” function of Figure 4, instructors are able to export the authored learning contents (in PIF file format) to SCORM or TW LOM, respectively. In other words, those authored learning contents could be designed for once, and then made to be conformant with various E-learning specifications in many times to support different learning platforms.

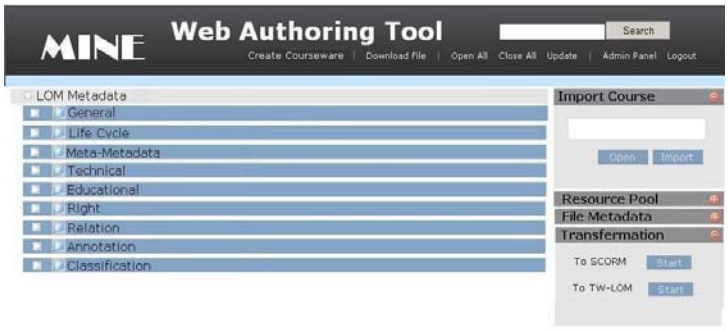

Figure 4. Transformation Wizard for supporting various E-learning specifications

■ Personalization in Authoring Process

As mentioned in section one, to edit metadata is not easy for the author who isn't the expert in information technology domain. For this reason, we use the data in author profile to simplify the procedure of editing the learning content and then automatically generate the essential value for SCORM format metadata by the author's editing history stored in his/her personal profile.

The author preference will cause the personalization layout of the functionalities of system. The access procedure of the author profile in our system is shown in Figure 5.

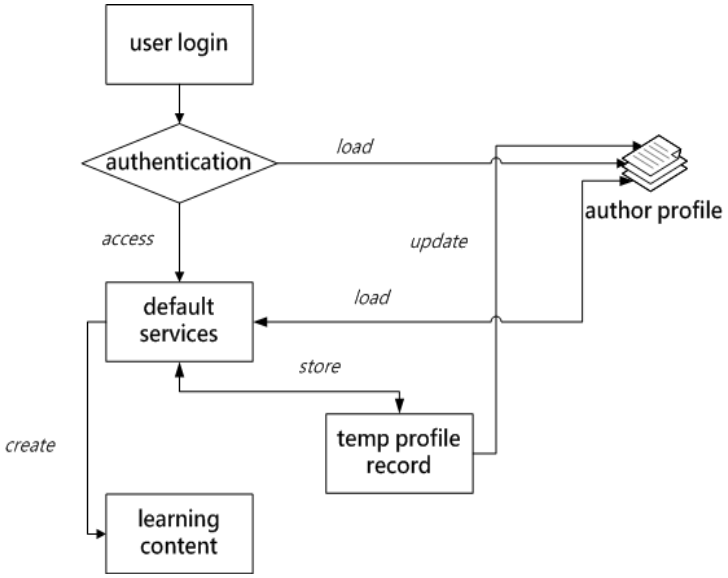

Figure 5. The access procedure of author profile

As login to the authoring system, the authentication mechanism will identify the user in the back-end database. After that, the system will load the relative author profile for specific user, and then set up the customized interface for that user. When user utilizes the default service proposed by our system, the operation process of the user will be stored in the temp author profile structure and update the back-end profile in asynchronous mode. After finishing all the authoring process shown in Figure 5, the learning content will be created. At the same time, system will use the information in author profile to create the essential metadata description file.

In order to make use of the authoring service in our proposed system in an easy way, the layout of user interface will be the main concern in this system. When author logging in the system through the authentication mechanism, the system will extract the author profile in the back-end database and then load the information to arrange the layout of user interface as shown in Figure 6.

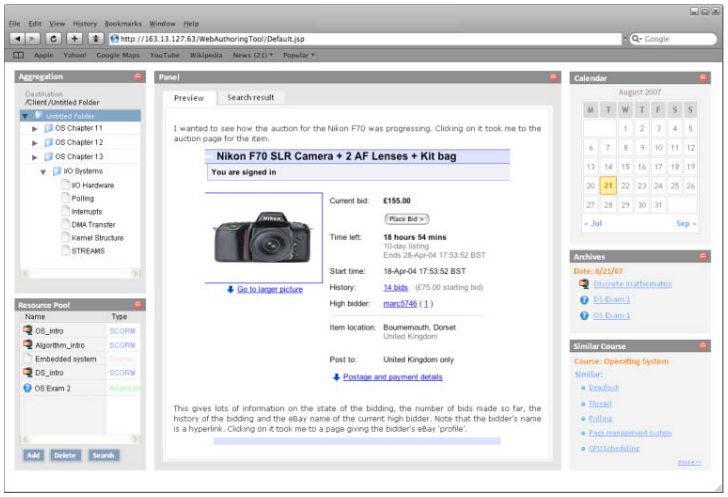

Figure 6. The layout of user interface

Each separated part in this user interface is set up by the specific author, and is developed as a single web service. Author could select the usable functionalities to compose his/her personalized authoring tool. After that, a specific service will retrieve the information from the profile shown in Figure 6. To take the created learning content for example, all the learning contents created by the specific author will be stored in author profile. When he/she logs in the system next time, the system will show all the authoring history to remind the author. Hence, the author won't have to spend much time in retrieving the learning contents or resources. What the author has to do is to focus on reorganizing the learning contents and learning design.

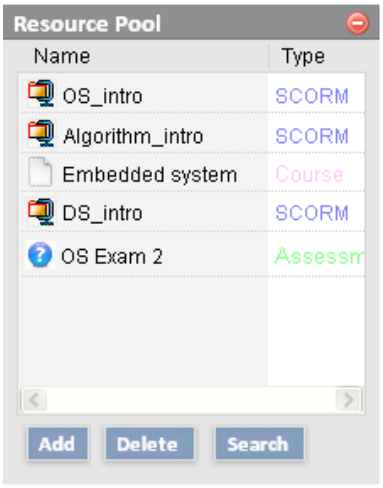

Figure 7. The authoring history recorded in author profile

The resource pool is one of the system services in our proposed system. The authoring history and corresponding learning resources could be retrieved in the resource pool. Different types of learning resources will be shown in different colors and descriptions (Figure 7). Authors could utilize these existing resources to reduce the total cost of generating a new course. After completing the learning content, the metadata will be made by referencing the author profile stored in temp profile data structure. When metadata file created, the system will package the whole relative learning materials into a zip file which is compatible with SCORM format or other acceptable formats, such as TW LOM and IMS QTI.

2. Learning Management System

This topic developed a learning management system named Intelligent Pervasive Learning System (iPLMS) which based on Sharable Content Object Reference Model (SCORM) standard, Question and Test Interoperability (QTI) standard, and Web 2.0 technique. As shown in Figure 8, iPLMS provides not only the basic learning functions but also the advanced learning functions for educators, students, and administers. The system enables educators to use, reuse, and share learning objects which are satisfied SCORM standard. Moreover, iPLMS also follows QTI standard to implement the assessment system that can let educators to integrate, reuse, and share assessment resources effectively and efficiently. Furthermore, the system developed a blog system to accomplish Web 2.0 learning environment. The following sections will describe the main functions of iPLMS in detail.

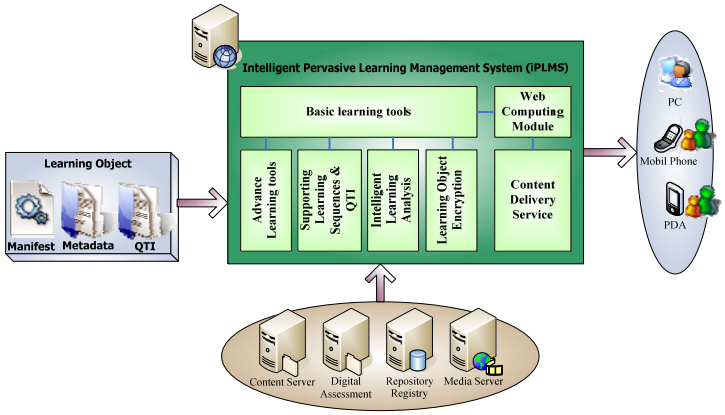

Figure 8. Architecture of iPLMS

■ Blog system

The blog system provides a new way of learning. The system developed based on the original blog functions, such as post articles, give comments, and the blog system also provided functions of learning management systems (LMS). Therefore, this system is a learning blog, as shown in Fig. 2. The learning blog includes several functions, which are described in below. The main function is still the same as traditional blog. But in the system we use these functions to connect each class and the participants in the class.

1. Portal: Portal is the interface of the system, and it organizes many functions in the system in single page. Portal is developed under the concept of i-google hence user can re-arrange their own type mainpage.

2. Blog: In the system, blog is the key element to connect the relation between students, teacher, and the class. Teacher, student, and each class have their own blogs. The content of blogs can be hyperlinked to each other and also can be used in the reference way.

3. RSS reader: The function is to provide user in the system to keep the latest information of the blog which user subscribed. RSS reader also default subscribes the news channel of the Yahoo! Taiwan.

4. Course management: Course management function provides teacher a space to create their classes. Teacher can start a class via this function, manage the status of online course and do the management of class blog.

5. Most popular course: There are many classes in the system. The function can show the most popular (Top 5) courses in the system. Once the students are interested in some courses and the courses are visitable, the students can join in the courses.

6. Text note: User can keep their note by using this function.

Figure 9. Screenshot of blog system

■ Assessment function

Due to SCORM standard does not focus on the assessment, it would cause that the resources of assessment cannot reuse and share. Therefore, this project applies IMS QTI standard to integrate the assessment resources effectively and efficiently. As shown in Figure 10, we implemented six item types which are true/false, single choice, multiple choice, pattern match, fill-in-the-blank, and essay, respectively.

Figure 10. Snapshots of the six item types

Through authoring tool, educators can produce needed tests and items which have satisfied QTI standard. Subsequently, they can upload the compression file to the iPLMS and then the system would parse the QTI metadata files to analyze which assessment elements packaged in the file. Consequently, each learner can administer an assessment after the conclusion of learning through the iPLMS, as shown in Figure 11. In this way, assessment resources can reuse in and share with other learning systems effectively and efficiently as long as they also follow IMS QTI standard.

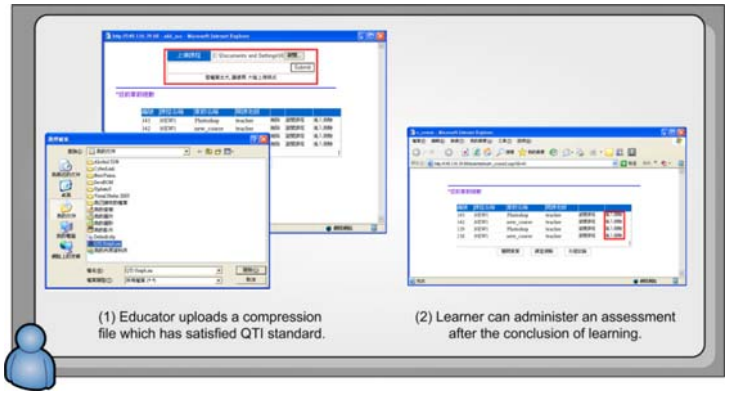

Figure 11. Administration of an assessment

■ Intelligent human-expert forum system

Figure 12 shows the architecture of the intelligent human-expert forum system. In the system architecture, users play two different roles at the same time. First is be a user who can ask questions and second is be an expert who can offer suggestions and solutions. The intelligent human-expert forum system consists of four major parts, the details of which are introduced as follows.

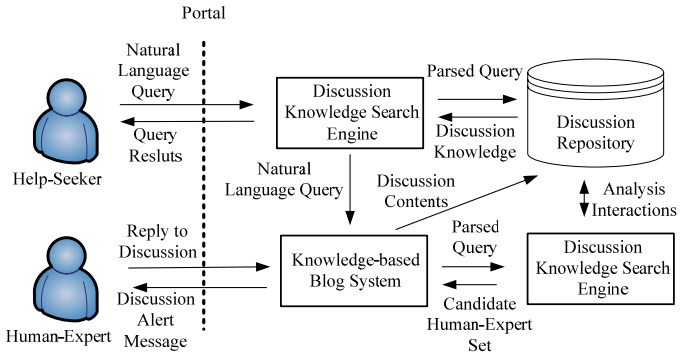

Figure 12. Architecture of the intelligent human-expert forum system

The discussion knowledge search engine is responsible for receiving the user's specific natural language query and generating the parsed query term to find relevant discussions from the discussion repository. The search engine employs the expanded query set and query technology to discover relevant discussions in the discussion repository. Subsequently, the discovered discussions return to the user to answer the specific query.

The knowledge-based blog system provides a way for the blog/forum to share knowledge. In addition, the discussion board plays an important role in solving questions by means of user cooperation, the discussion knowledge search engine, the discussion repository, and the human-expert set discovering mechanism. The cooperating scenario is introduced as follows. First, the user submits a natural language query to the discussion knowledge search engine, and then the search engine would parses and expands the query as the expanded query term set. Following that, the expanded query term set along with the query can be used to find information relevant to the discussion, which would be sent to the questioner. If the user is satisfied with the answer, the process will be terminated. If not, the natural language query would be posted on the forum for further discussion. Whenever the forum receives a new post, it would pass the expanded query set to the human-expert set discovering mechanism for looking for the candidate human-experts who are relevant to answer the query. Consequently, the system would actively send alert messages to the experts so that they can participate in this discussion. Figure 13 shows the user interface of the forum portal.

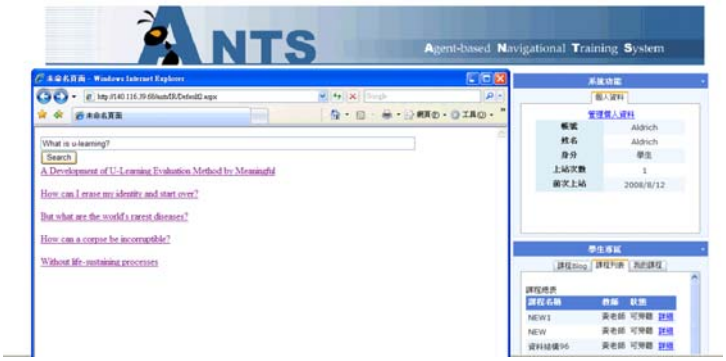

Figure 13. User interface of the human-expert forum system

3. Assessment and Intelligent Learning System

Assessment is the process of measuring and analyzing student performance or learning skill, and giving feedback to the teacher and student in how to improve future performance. With the assessment result and analysis, instructors can revise the related teaching strategies and change the learning materials to help the students to overcome the obstacles.

We mainly use a tool called the S-P Chart (Student-Problem Chart) integrated in our proposed on-line assessment system. There are two main purposes in our study. First, teachers can measure and understand learners' further learning performances with caution index for course for students (CS) provided in S-P Chart. Second, teachers are able to observe items quality with caution index for problems (CP) provided in S-P Chart with this integrated system. In addition, the Bloom Taxonomy of Educational Objective is commonly used for categorizing cognitive domains. In our research, we also integrate the Bloom taxonomy to assist categorizing our test items. Thus, after the assessments were held, teachers are not only able to evaluate the learners' ability, but also to point out the deficiency of learners in the assessments.

■ System Architecture

Our proposed system contains three main functions for students, teachers and system administrators. As Figure 14show, the functions for students are 1) Grade Search, 2) On-line Assessment and 3) Individual Information Transaction. The functions for Teachers are 1) Item Design, 2) S-P Chart and Bloom Analysis and 3) Scores Management. With these functions, teachers are able to diagnosis learners and to evaluate learning objects after the assessment.

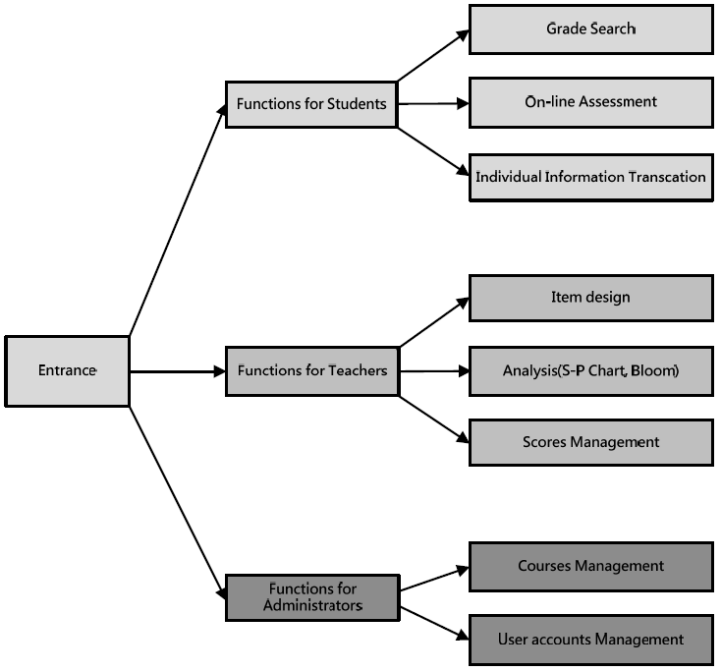

Figure 14. system architecture

About the flow chart of running process, we can divide it in ten steps.

(1) Course Establish/Transaction: At the beginning, administrators create courses and register all users' information.

(2) Update/Add Test Item: Teachers edit test items. Update or add test items.

(3) On-line Assessment: Students attend the assessment with browser.

(4) System corrects each test sheet when assessments were done: When students finish the assessment, the system will correct each item in the assessment.

(5) Mark the correct answers of each wrong answer: When system finish correcting test items, system will also mark the correct answers.

(6) Make Bloom Analysis Results for each student: When all items are corrected and right answers are marked, system will provide Bloom analysis result for each student.

(7) Save Bloom Analysis Results: Bloom analysis results will be saved in the database.

(8) Generate S-P Chart: S-P Chart analysis will be generated.

(9) Save S-P Chart: Save the S-P Chart analysis results in the database.

(10) Students and Teachers can retrieve the analysis results of S-P Chart and Bloom: In the final step, students and teachers can search both S-P Chart and Bloom analysis results as well. For students, they want to know their learning ability. For teachers, they can observe students' learning ability and items' qualities.

■ Mechanism in Proposed System

As mentioned, we use caution index for student and caution index for problem to estimate learning result and item quality. We arrange them with two charts shown as Figure 15.

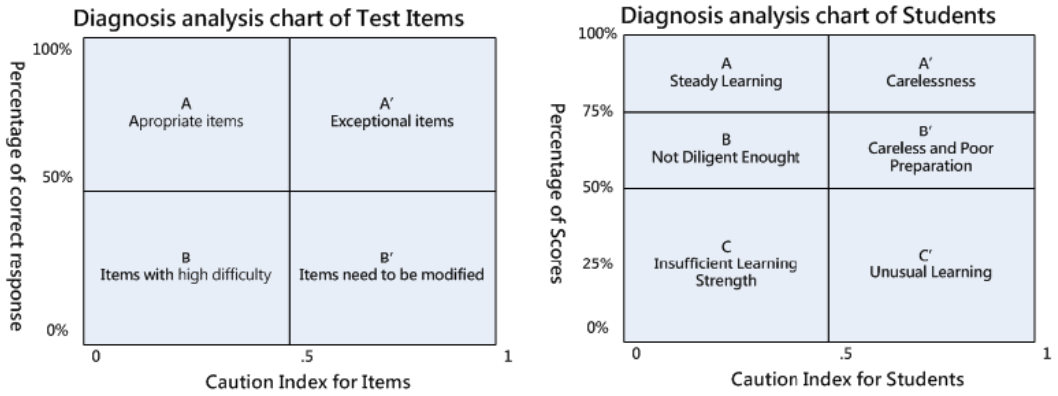

Figure 15. Diagnosis analysis chart of Test Items and Students

A. Diagnosis analysis chart of Test Items:

Zone A:
In zone A, all items have well discrimination. With these items, system can distinguish students who have well academic achievement or not.

Zone B:
In zone B, all items have high difficulty and proper for distinguishing the students who have high academic achievement.

Zone A':
In zone A', items have impure element in the question structure which includes stem and choices. The test items need modify the stem or the improper choices.

Zone B':
Items in zone B' are seriously bad and have much impure elements. That means the items need to be modified immediately.

B. Diagnosis analysis chart of Students:

Type A:
When students locate in this area, they have steady learning behavior and have excellent performance.

Type B:
When students located in this area, that means students' learning behavior is stable but not good enough, and they need work harder.

Type C:
Students not study enough and their performance is poor. They need study much harder.

Type A':
The students who locate in this area study hard and have good performance. But they might make some mistakes with carelessness.

Type B':
When students locate in this area, they won't have well preparation for the assessment and attend the assessment with carelessness.

Type C':
Students in this area never read the book.

When teacher want to setup an assessment, it's a better way to make sure that the item is proper or not. A good item can make a well judgment for students' performance. Ebel & Frisbie (Ebel & Frisbie, 1991) provided the evaluation chart for the item discrimination index. Table 1 shows the detail. Teachers can pick item with this table.

Table 1. The evaluation standard chart of item discrimination index

Item discrimination index	Test assessment
Over 0.40	very excellent
0.30 ~ 0.39	excellent, but maybe need some corrections
0.20 ~ 0.29	good, but should do more corrections
Below 0.19	bad, need erasure or corrections

■ Proposed System

We propose an on-line assessment system supporting item and assessment authoring and S-P Cart analysis function and Bloom cognition level setting. In Figure 16, teacher can hold assessments and edit test items. Teacher can switch to other assessment by selecting other selection in the combo box in the upper part.

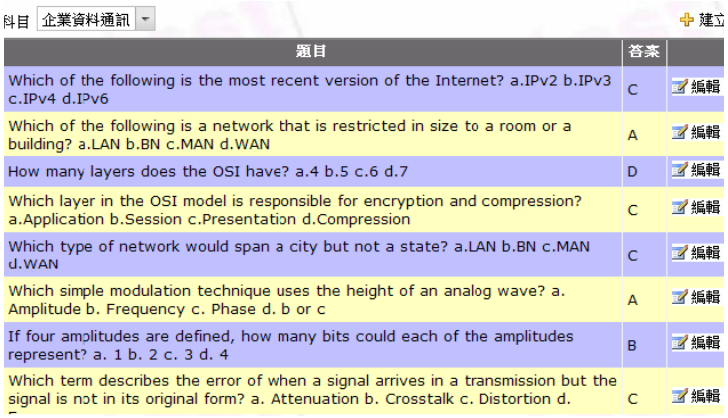

Figure 16. Assessment design

One of the special features in our proposed system is diagnostic and analysis. We diagnose students' learning results with caution index for student and diagnosis analysis chart. We also analyze items' attribute with caution index for items and diagnosis analysis chart. It provides an efficient way to evaluate the qualities of items and students.

Test item diagnostic and analysis is shown in Figure 17. The left hand side shows the items in assessment, the CP index and the item type. Right hand side shows the test item classification according to the test item caution index.

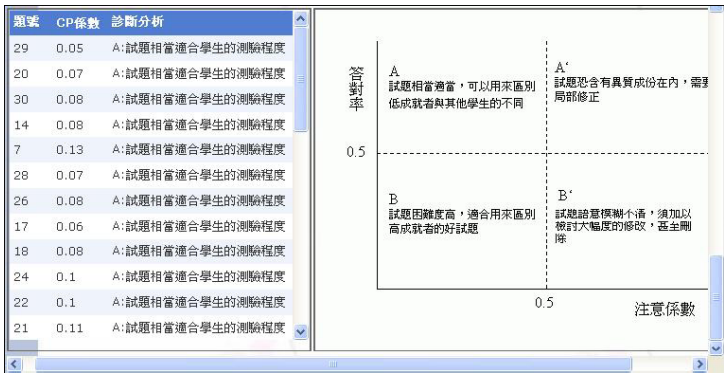

Figure 17. Test item diagnostic and analysis diagram

The student diagnostic and analysis is shown in Figure 18. The left hand side shows the students who attend the assessment. The caution index of student and student's analysis results are listed as well. Right hand side shows the student classification according to the caution index of student.

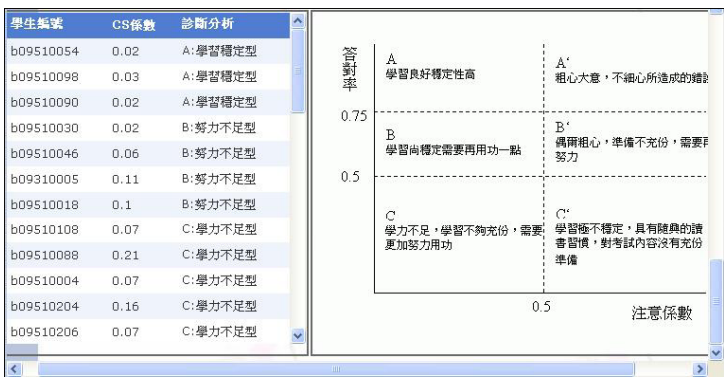

Figure 18. Students diagnostic and analysis diagram

4. Visualization of testing analysis

In this study, we implemented at "Special issue on e-Learning" course at Graduate Institute of Information & Communication, Southern Taiwan University of Technology (STUT) in first semester in 2007. The class has one instructor and 12 graduate students. An online BBS in Figure 19 had been established for group communication. Although those students did not know each other at initial stage, they did know how to use BBS as group communication tool.

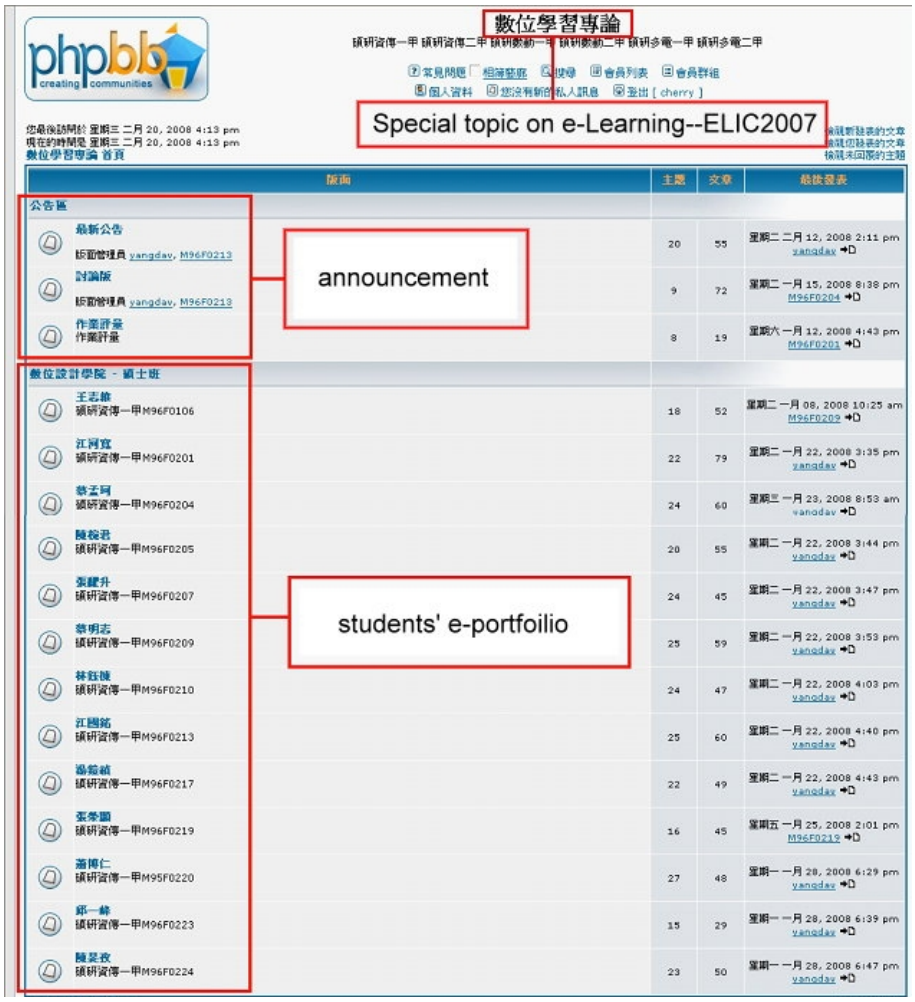

Figure 19. ELIC2007 layout with announcement and students' e-portfolio

■ The process of experimentation

A semester consists of 18 weeks. There are 5 stages in this study. Firstly, the class was given in traditional classroom at the first 2 weeks. Secondly, the 3rd week, a pre-test was given to make sure of their proficiency in subject matter. Also, a forum, ELIC2007 in Figure 2 had been built as communication platform. The instructor gave a kick-off and followed up such as quick responses in terms of social, teaching or cognitive presence. Those students were encouraged and asked to join sharing of their own insights publicly. The third stage began at 7th week, instructor chose theme-based BBS and announced criterion of grading. It aims at testing:

(a) whether proposing subject matter issues affect cognitive presence and

(b) whether proposing ASKS as immediate grading responses affect learning quality.

The weight of those 4 criterions can be calculated by different weights such as Table 2. Then, student's grade (76) can be attained as Table 3.

Table 2. Criterion Weight

Criterion	Weight
Attendance	10%
Participation	20%
Articulation	30%
Relevance	40%

Table 3. A Sample of student's weighted score

Criterion	Score	Weight	Weighted
Attendance	100%	10%	10%
Participation	72%	20%	14%
Articulation	78%	30%	23%
Relevance	72%	40%	29%

The fourth stage, the instructor gave course related questions or theme-based questions in BBS and chose selective feedback such as only responses for students who had wrong answer. It aims at testing whether immediate responses from instructor affect teaching presence. At final stage, a pencil-and-paper test was given to examine the learning outcome in the whole semester. The whole flowchart of this study is shown in Figure 20.

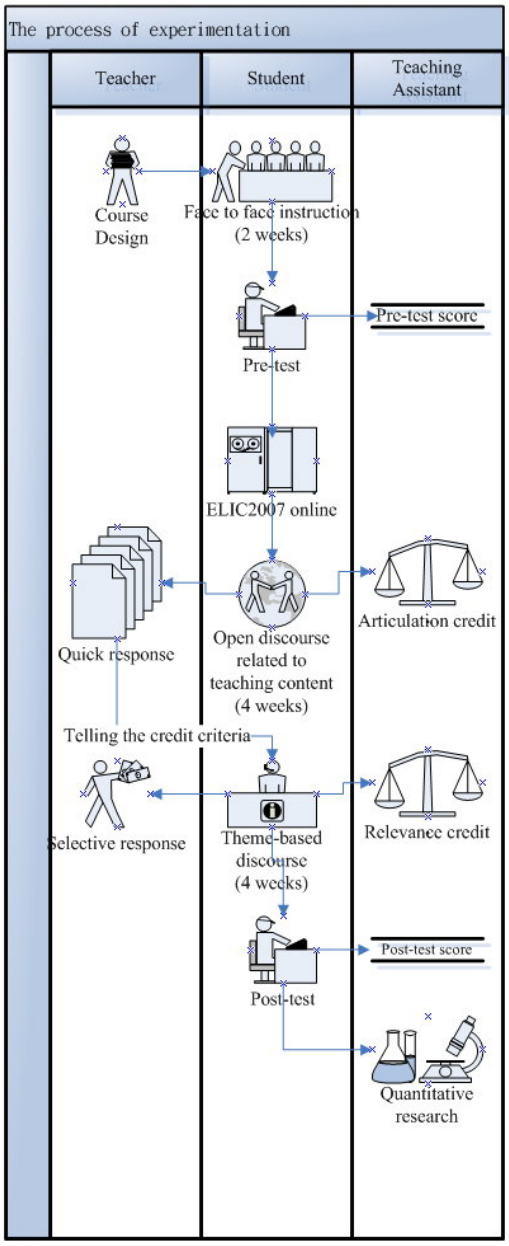

Figure 20. The flowchart of this study

■ Data analysis

The assessment used in this study adopted ASKS, proposed by Anderson (2003). 4 criteria to be accounted consist of attendance, participation, articulation, and relevance. Meanwhile, the score on pre-test and post-test was compared. Whereas attendance stands for joining discussion; participation stands for the number of post messages in BBS; articulation focuses on the quality of posted message. A Linkert 5-scale grading is given for those three criteria. By contrast, a relevance criterion aims at the degree of theme-based response by Linkert 7-scale grading.

■ Results of this study

A. Social Presence on affective response, open communication, and group cohesion dimensions

The trend of affective, open communication and group cohesion dimensions are shown Figure 4~6. Given the BBS as communication, affective responses in Figure 21 were rapidly increased at 1st stage

among students. It, however, rapidly decreased at 2nd stage. The instructor used event to trigger affective responses at 2nd stage. By contrast, open communication and group cohesion dimensions in Figure 22 and Figure 23 are highly irrelevance no matter whatever the instructor did.

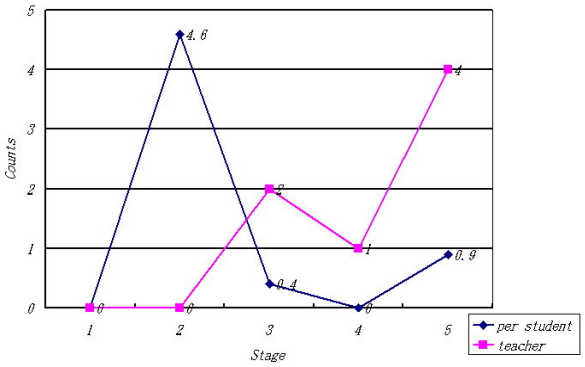

Figure 21. Trend of affective response

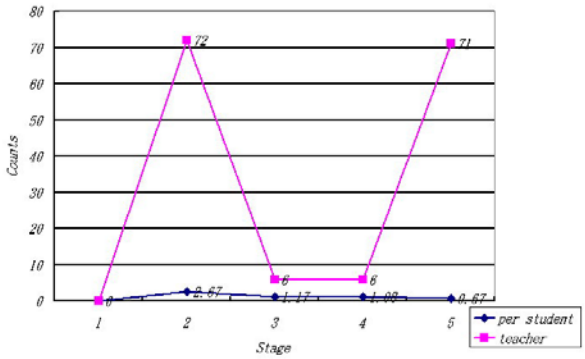

Figure 22. Trend of open communication

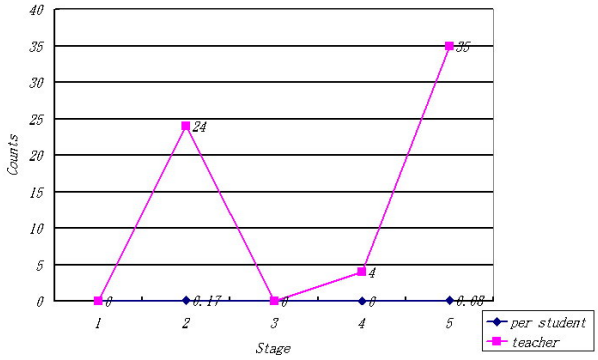

Figure 23. Trend of group cohesion

B. Cognitive Presence on trigger event, exploration, integration, and resolution actions

At the third stage, the instructor proposed course related issue, four criteria consisting trigger event, exploration, integration, and resolution were analyzed. The former 2 criteria showed their positive responses whereas the latter 2 criteria were no progressive evidences among 12 students (A..L) in Figure 24. In other words, high-order thinking in this study did not occur. Most students just replied their insights instead of integrating posted messages and giving resolutions among students. The student H did quit this course at 3rd stage, so the exploration numbers appeared negative number.

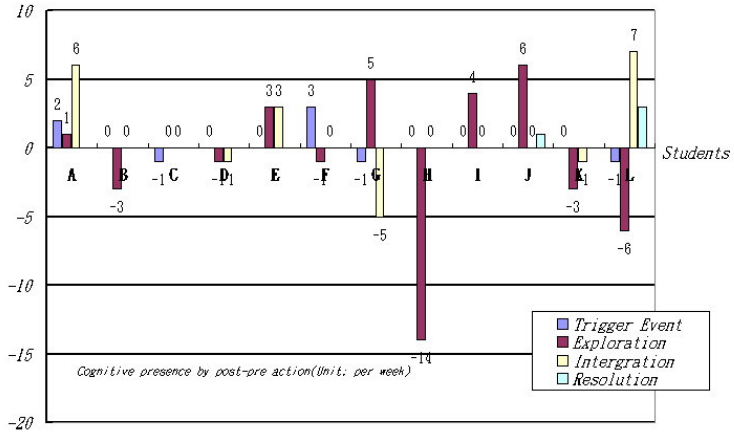

Figure 24. A comparison at the third stage for cognitive presence by post-pre action

In this study, the data collected from ELIC2007 platform and based upon ASKS grading mechanism were summarized by 4 criteria: attendance, participation, articulation, and relevance dimensions. In Table 4, attendance, pre-participation vs. post-participation, pre-articulation vs. post-articulation, and pre-relevance vs. post-relevance at 3rd stage were identified.

Table 4. Summary of 12 students' information

ID	Attend	Pre Posted #	Post Posted #	Pre-A.	Post-A.	Pre-R	Post-R.	Pre-test	Post-test
A	9	10	19	2.8	3.42	3.9	4.53	70	70
B	8	4	13	3	3.77	3.75	4.62	65	70
C	5	5	9	2.8	3.22	3.8	3.89	90	80
D	8	4	11	3	3.55	4	4.55	75	80
E	8	5	11	2	3.27	2.6	4.18	80	70
F	9	4	15	3.25	3.47	4.25	4.2	80	70
G	9	7	10	2.71	3.5	3.43	4.3	65	50
H	7	9	13	2.44	2.85	2.67	3.54	75	90
I	5	4	7	3.25	3.43	4.25	4.29	75	80
J	6	9	3	2.56	4	3.44	5.67	90	70
K	2	2	23	3.5	1.78	3	3.33	70	100
L	7	4	5	2.5	4	3.5	5.4	80	60

Based on Table 3, this study adopts 2 stages for analyzing those data. Firstly, a standardized procedure is processed according the differences between pre and post scores. Secondly, parallel axis software (Inselberg, 1981) was computed. Then, the plot was generated by Microsoft Access in Figure 24.

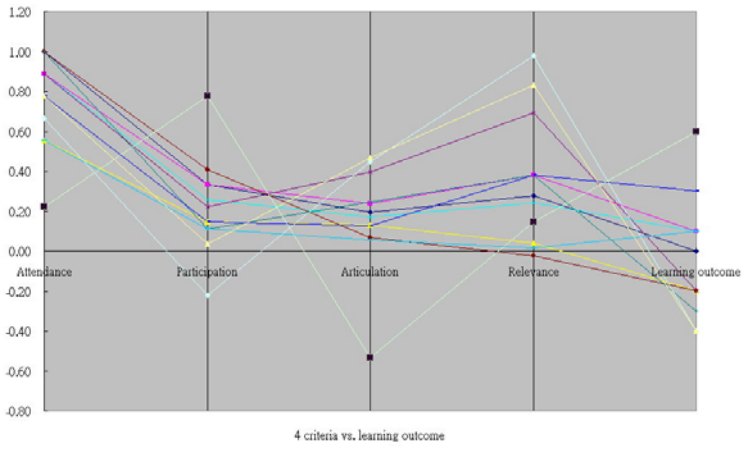

Figure 25. 4 criteria vs. learning outcome by "Parallel Coordinates"

In Figure 25, that the highest grade students had low 3 criteria except the number of posted messages is beyond our common sense as he/she might join the class at the last few weeks and posted messages such as how to use some software and social messages such as "hi", "how are you doing?", "I am coming to join with you" …etc. Therefore, an interview was given in follow-up.

The student told that the score from pencil-and-paper test highly depended on the degree of student's memorization instead of understanding. After one month, he almost forgot what he attained in the class. By contrast, another student who was lowest score could tell something in the class and apply what he learned from the class. In other words, BBS forum can keep track of students' learning processes

and help students to get insights from peers in a community of inquiry for true learning.

C. The results of 3 presences at different stages

In Figure 26, it shows that learning experiences profoundly shapes students' educational experiences while the instructor proposed subject matter related question to clarify students' understanding at stage 4. Their posted responses attained more than 2.5 times from 46 to 117. Many students reported that those questions positively affected their participation in the discussion and their individual cognitive processes for engaging with the teaching material in the real class. In addition, students indicated that those questions provided a clear advantage in facilitating the work of small groups.

As for the comparison among the 3 presences along with 5 stages, Instructor and students took more efforts on social, teaching, and cognitive presences from Stage 1 to Stage 2. Therefore, another peak occurs at Stage 2 in Figure 26.

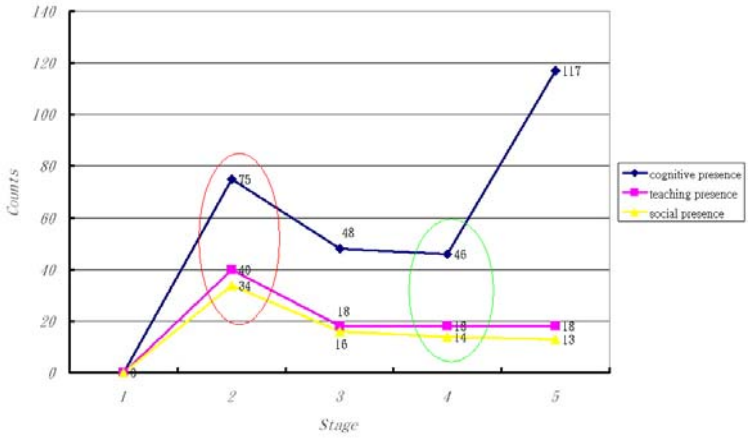

Figure 26. 3 presences at different stages

Based upon the results from section 4, some discoveries are shown as follows, (a) Providing open communication environment can promote "social presence"; (b) Offering quick responses can enhance "teaching presence"; (c) Learning process may be inconsistent with learning outcome; and (d) Setting course-related discourse can augment "cognitive presence".

Conclusions

Many conventional activities in our daily life have become more convenient and ubiquitous in line with the Internet development. One of the most important and obvious activity is learning. People are able to easily acquire a great quantity of digitalized learning resources all over the world, as well as to share those learning resources with others. Nowadays the digitalization of learning contents will not become a critical issue for those who want to delivery their learning contents via the Internet. Contrariwise, the proliferation and emergence of learning resources over the Internet cause the problems of information overloading and disorientation.

In our research groups, we proposed an integrated learning environment including the authoring system, learning management system, and intelligent analysis mechanism for the assessment.

One of our research topics proposed online courseware authoring system based on WEB 2.0 to support various E-learning specifications. With similar user experience lies in rich-client features, instructors and content providers are able to perform the same operations, which were supposed to be available in standalone applications, in a web browser. Some learning contents stored in back-end learning content repositories could be directly manipulating during the authoring phase without pre-downloading them to the local machines. An index mechanism, named as handler, serves this purpose to affiliate the online authoring process and the retrieved learning resources in the back-end servers. This will be greatly saving the extra efforts while acquiring the online learning resources. We also take account into the interrelationship among various E-learning specifications. So far our proposed authoring system supports the transformation among IEEE LOM, SCORM, and TW LOM.

Besides, a service-oriented functionality is embedded in our proposed system. With the rich-client and user experience, authors are able to set up their personalized authoring functionalities, which were supposed to be available only in standalone applications, in a web browser. Some learning resources stored in back-end computer or storage device could be manipulated during the authoring process without pre-downloading. With the profile recorded in IMS LIP specification, the authoring history will be stored in the specific author profile. And with the author profile, our proposed authoring system could simplify the authoring process for the authors who are not experts in information technology domain. It will be significantly reduce the time cost in authoring phase.

The research topic of learning management system have studied the entire knowledge building and delivering processes of a help-seeking system, and it gives the following approaches to counter the disadvantages of the traditional forum or blog system. The forum/blog can actively invite human-experts to solve the given problem. Accordingly, questions would not be neglected, and the issue would be solved in a short time. Moreover, the answers would be passed peer validation and become static knowledge in forum repository. The proposed human-expert forum system can improve the efficiency of knowledge building, and the help-seekers can use their own thinking to find the tailored solutions.

We use Sato's Student-Problem Chart to diagnose students' learning conditions with assessments they attended. We also provide an on-line assist system for assessment added on our proposed authoring system as we mentioned in previous section. According to the S-P Chart analysis and the Bloom taxonomy of items, we can divide all items in four types, and divide all students in six types. With these four types of diagnosis analysis chart of items, teacher can modify or delete the items which are not proper. With these six types of diagnosis analysis chart of students, teachers can realize learners' situation. For improving our system, we could build an on-line learning management system to support the learning content provided. For experiment, we analyze the pretest and posttest of one class for the experimental group and control group. We find out the learning abilities variation to apply individual learning in e-learning environment. These experiment results provide us a valuable example for the learning management system or tutoring system construction in the future.

In the fourth sub research, we reveal that the traditional way on pencil-and-paper test cannot verify what students' learning in an inquiry of community. Therefore, an asynchronous BBS may be useful for keeping students' learning e-portfolio. BBS can be a supplement for an inquiry of community in terms of attaining a comprehensive evaluation. This study is a field or experimental study while Anderson (2003) proposed "a model of inquiry of community" for e-Learning practice. The model needs to be verified at different educational context. The most part of results in this study comply with Anderson's model. Furthermore, the results in this study give some insights for this model.

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Evaluation of Project Achievement

Journal Publications		
Chang, H. P.; Shih, T. K.; Li, Q.; Wang, C. C.; Chao, L. R. (2008) **An Adaptive Caching Strategy for m-Learning Based on SCORM Sequencing and Navigation**	World Wide Web Journal	Accept
Chang, W. C.; Yang, H. C.; Shih, T. K. (2008) **Using S-P Chart and Bloom Taxonomy to Develop Intelligent Formative Assessment Tool**	Journal of Distance Education Technologies	Accept
Huang, Y.M.; Kuo, Y. H.; Lin, Y. T.; Cheng, S. C. (2008) **Toward Interactive Mobile Synchronous Learning Environment with Context-awareness Service**	International Journal of Computers & Education	Accept
Huang, Y. M.; Lin, Y. T.; Cheng, S. C. (2008) **An Adaptive Testing System for Supporting Versatile Educational Assessment**	International Journal of Computers & Education	Accept
Kuo, Y. H.; Huang, Y. M. (2007) **MEAT: An Authoring Tool for Generating Adaptable Learning Resources**	Educational Technology & Society	In Press
Lin, F. H.; Shih, T. K.; Kim W. (2008) **An Implementation of the CORDRA Architecture Enhanced for Systematic Reuse of Learning Objects**	IEEE Transactions on Knowledge and Data Engineering	Accept
Conference Publications		
Chang, H. B.; Shih, T. K.; Wang, C. C. (2008) **An Interactive Video Course Platform with Authoring and Playback Systems**	Advanced Information Networking and Applications	Accept
Chang, H. P.; Hung, J. C.; Wang, C. C.; Weng, M. T.; Shih, T. K.; Lee, C. Y. (2008) **A Learning Content Adaptation Tool with Templates for Different Handhelds**	Advanced Information Networking and Applications	Accept
Chen, J. H.; Shih, T. K.; Yeh, S. W.; Lee, C. Y. (2008) **Combine Personal Blog Functionalities with LMS Using Tools Interoperability Architecture**	Advanced Information Networking and Applications	Accept
Wang, T. H.; Yen, N. Y.; Du, Y. L.; Shih, T. K. (2007) **A Courseware Authoring Tool for Achieving Interoperability among Various E-Learning Specifications Based on Web 2.0 Technologies**	Advanced Distance Education Technologies	Accept
Yen, N. Y.; Wang T. H.; Lu, Y. S.; Shih, T. K. (2008) **Using IMS LIP specification to achieve Online Personalization Personalized Authoring System Based on Web Service Architecture**	Advanced Distance Education Technologies	Accept

Table of Promoted Research Achievement

Date：October 15th, 2008

□ 可申請專利　■ 可技術移轉

國科會補助計畫	計畫名稱：以教材標準化及 Web 2.0 技術提升線上學習成效--以多媒體教材為例 計畫主持人：施國琛 計畫編號：NSC 96－2524－S－032－001－ 學門領域：SN 數位學習國家型計畫
技術/創作名稱	以教材標準化及 Web 2.0 技術提升線上學習成效--以多媒體教材為例
發明人/創作人	施國琛、楊錦潭、黃悅民、洪啟舜、張文智、王德華
技術說明	中文： 提供數位學習環境參與者，不論是在數位課程內容的產生、學習活動的進行以及基於學習過程後所進行之測驗與結果分析，讓教學者與學習者能夠清楚的了解其在此環境中所闆演之角色與定位。與新一代網際網路技術的結合，將以往的課程、試題編輯行為進行大量的簡化並導入個人化的編輯介面，以降低非專門領域使用者操作上之複雜度，且可利用數位標準轉換模組來進行數位學習標準間之格式轉換以達成標準之互通性；在學習者方面，本計畫建立了一智慧型學習導引平台，透過 BLOG 模組讓學習者能夠即時取得與正在進行中之學習活動相關知識，並能夠於課程結束後由試題測驗模組來自行將相關的測驗內容提供給學習者進行課後評量；再者，根據測驗後的結果進行試題難易度之分析，藉由此方式來給予在試題編輯方面之輔助與建議；最後根據學習者學習過程之分析來給予教學者設計教學活動時的幫助。
	英文 No matter the generation of distance learning content, the process of learning activities and the analysis of the assessment results, our proposed research project provides a way that could assist the participants realize his/her role in the distance learning environment. With the integration of the internet technologies, we reduce the operation complexity for the users who are not the experts in this domain by integrating the personal authoring interface to assist the users in generating the course content and assessment items and we also proposed a transformation mechanism for interoperability between various e-learning standards. In learner aspect, our project construct an intelligent pervasive learning management system, learners could get the related information about the learning activities through blog module. After that, learners could also receive the assessment content through the specific module. Furthermore, we could analyze the difficulty degree by the assessment results. Through the mentioned above, we could increase the efficiency in teaching and learning and assist the teachers in designing the learning activities.

※1.每項研發成果請填寫一式二份，一份隨成果報告送繳本會，一份送貴單位研發成果推廣單位（如技術移轉中心）。

※2.本項研發成果若尚未申請專利，請勿揭露可申請專利之主要內容。

※3.本表若不敷使用，請自行影印使用。

可利用之產業及 可開發之產品	可利用之產業： 1. 一般企業或學校內部員工訓練機制 2. 數位學習產業、數位內容提供商、系統提供商 3. 行動產業加值服務 4. 出版業 可開發之產品： 1. Open Source 課程編輯工具 2. 智慧型學習平台 3. 試題難易度之分析工具
技術特點	1. 採用網路服務的架構，進行相關系統之開發，減少開發後系統安裝與維護之後續事項的處理。 2. 將個人化的元素整合入所提出之課程編輯系統，簡化與輔助非相關領域人員於編輯課程內容實之複雜度；並利用此工具來產出符合國內外著名之數位學習標準之學習內容。 3. 將 WEB 2.0 之概念融入既有之學習管理平台，利用 Blog 與 RSS 的技術來作為學習者進行學習活動時之參考。 4. 智慧型測驗系統，將課程內容與試題作緊密之結合，並利用 IMS Common Cartridge 標準中所提及之 Tool Interoperability 來作為系統工具建置實之依據。 5. 試題難易度之分析機制將可根據學習者於應答時之相關回應係數進行整合分析，作為往後教學者製作試題時之重要參考依據。 6. 分別以 SCORM、QTI、Common Cartridge 標準開發數位學習資源，容易整合其他不同種類之學習管理系統，教材內容亦可與國內外相關機構研發之相關學習平台共用，將有助於台灣在國際上學術地位之提升。達成資源分享之目標。
推廣及運用的價值	1. 改變以往根據傳統系統開發模式所建立之數位學習工具，將所有之功能模組分別以網路服務之方式進行後續開發，利於後續維護或與其他研究組織進行整合。 2. 藉由校際間不同系所之合作交流，能夠培養參與此計畫之研究人員於系統開發或問題解決之能力，使得研究人員能夠具備更優越的競爭力。 3. Web 2.0 時代的來臨造就了許多知識與技術能夠迅速的傳播與分享，學習者或教材編輯者能夠利用瀏覽器的操作來完成原先複雜的操作流程；並可藉由 Blog 與 RSS 技術來增進學習者之學習意願。 4. 利用國內外著名之數位學習標準作為課程產出之依據，並能夠藉由簡單的轉換機制來達到不同標準間之互通性，有益於未來國內於開發數位學習環境之幫助。

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